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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte DAVID R. SHAFER, YUNG-HO CHUANG,
and J. JOSEPH ARMSTRONG

Appeal 2009-000868
Application 10/646,073[1]
Technology Center 2800

Decided: February 23, 2010

Before SCOTT R. BOALICK, MARC S. HOFF, and
CARLA M. KRIVAK, *Administrative Patent Judges.*

BOALICK, *Administrative Patent Judge.*

DECISION ON APPEAL

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[1] The real party in interest is said to be KLA-Tencor Technologies Corporation. (App. Br. 2.)

This is an appeal under 35 U.S.C. § 134(a) from the final rejection of claims 43-99, all the claims pending in the application. We have jurisdiction under 35 U.S.C. § 6(b).

We affirm.

STATEMENT OF THE CASE

Appellants' invention relates to a catadioptric optical system that can be used for microscopic imaging, inspection, and lithography applications. (Spec. 2:14-15.)

Claim 43 is exemplary:

> 43. An objective for use with light energy having a wavelength in the range of approximately 157 nanometers through the infrared light range, comprising:
>
> at least one focusing lens having diameter less than approximately 100 millimeters receiving said light energy and transmitting focused light energy;
>
> at least one field lens having diameter less than approximately 100 millimeters, receiving said focused light energy and transmitting intermediate light energy; and
>
> at least one Mangin mirror element having diameter less than 100 millimeters receiving said intermediate light energy and providing controlled light energy through an immersion substance to a specimen;
>
> wherein each focusing lens and each field lens is formed from a single glass material and aligned substantially along an axis, and further wherein said Mangin mirror element, said at least one focusing lens, and said at least one field lens are configured to balance aberrations therebetween, said aberration balancing reducing decenter sensitivity of the Mangin mirror element, said at least one focusing lens, and said at least one field lens.

The prior art relied upon by the Examiner in rejecting the claims on appeal is:

Yonekubo	4,108,794	Aug. 22, 1978
Shafer	2001/0040722 A1	Nov. 15, 2001
Deutsch	WO 01/57563 A2	Aug. 9, 2001

Claims 43-51, 53-74, 76-86, and 88-99 stand rejected under 35 U.S.C. § 103(a) as being obvious over Shafer and Yonekubo.

Claims 52, 75, and 87 stand rejected under 35 U.S.C. § 103(a) as being obvious over Shafer, Yonekubo, and Deutsch.

Only those arguments actually made by Appellants have been considered in this decision. Arguments that Appellants did not make in the Briefs have not been considered and are deemed to be waived. *See* 37 C.F.R. § 41.37(c)(1)(vii).

ISSUES

Appellants argue that the Examiner erred in rejecting claims 43-99 because the catadioptric imaging system of Shafer does not have its elements aligned substantially along a single axis and is not configured to balance aberrations between elements, where the aberration balancing reduces decenter sensitivity of the elements of the design. (App. Br. 12-15; Reply Br. 2-5.) In addition, Appellants argue that the Examiner erred in combining the use of an immersion substance, as taught by Yonekubo, with the system of Shafer. (App. Br. 15-20; Reply Br. 5-7.)

Appellants' arguments present the following issue:

Has the Examiner erred in rejecting claims 43-99 under 35 U.S.C. § 103(a)?

The resolution of this issue turns on the following subsidiary issues:

1. Has the Examiner erred in finding that Shafer teaches that its elements are aligned substantially along a single axis?

2. Has the Examiner erred in finding that Shafer teaches that it is configured to balance aberrations between elements, where the aberration balancing reduces decenter sensitivity of the elements of the design?

3. Has the Examiner erred by improperly combining the use of an immersion substance, as taught by Yonekubo, with the system of Shafer?

FINDINGS OF FACT

The record supports the following findings of fact (FF) by a preponderance of the evidence.

The Specification

1. Appellants' Specification states that:

> One advantage of the present design is relatively loose manufacturing tolerances. Specifically, the decenter tolerances of individual lenses are relatively loose. Having loose decenter tolerances for individual lens elements tends to simplify the manufacturing requirements of the system. Any lens decenters encounterd [sic] during manufacturing may cause on-axis coma, a phenomenon that can be difficult to compensate without introducing other residual aberrations. Using the present design, it is possible to reduce the decenter sensitivity of the lens and mirror elements by carefully balancing the aberrations within the catadioptric group

> 312 and focusing lens group 311. Total aberrations of the catadioptric group may be optimized using the design of FIG. 3 to balance the compensation required by the field lens group 305 and focusing lens group 311.

(Spec. 20:7-23.)

Shafer

2. Shafer describes a broad band deep ultraviolet/vacuum ultraviolet catadioptric imaging system for optical imaging and inspection. (Abstract; ¶¶ [0003], [0032].) Shafer includes several embodiments that employ two basic catadioptric objective design approaches. (¶ [0035].) "The first design approach uses a reflective lens mirror element that is folded such that the optical axis is at an angle to the optical axis of the major refractive components." (¶ [0035].) "The second design approach uses a reflective lens mirror element that has its optical axis mostly coincident with the optical axis of the major refractive components." (¶ [0035].) "The second design approach has the optical axis of a Mangin mirror coincident or nearly coincident with the optical axis of the refractive components." (¶ [0036].) "This design provides relatively relaxed manufacturing tolerances and increased design flexibility." (¶ [0036].)

3. Shafer teaches that:

> [o]ther significant advantages of the current invention include the ability to correct for primary, secondary, and higher order chromatic variations in focus, as well as correction for primary, secondary, and higher order lateral color, and corrections made for the chromatic

> variations of aberrations such as spherical, coma, and astigmatism.

(¶ [0039].) In the embodiment of Figure 1, Shafer discloses that:

> [t]he image forming optics 103 and the catadioptric objective 102 may each and together be fully corrected for aberrations. Such aberration correction permits testing the image forming optics 103 and the catadioptric objective 102 as separate units. Alternately, aberration correction may be shared between the catadioptric objective 102 and the image forming optics 103.

(¶ [0062].) Similarly, in the embodiment of Figure 2, "[o]ne implementation of the image forming optics 204 is to have them and the catadioptric objective 202 each fully corrected for aberrations. . . . An alternate technique is sharing aberration correction between the catadioptric objective 202 and the image forming optics 204." (¶ [0070].) Shafer teaches that "the designs of FIGS. 1 and 2 are well suited for florescence measurements." (¶ [0073].)

4. The embodiment of Figure 3 describes an objective 300 that includes a first field lens 304, fold mirrors 305a and 305b, Mangin mirror 306, second field lens 307, and focusing lens 308. (¶¶ [0074] – [0079]; Fig. 3.) The field lenses 304, 307 and focusing lens 308 are aligned substantially along the same optical axis. (¶¶ [0076] – [0078]; Fig. 3.) The fold mirror 305a reflects light at 90 degrees to that optical axis, but "[s]ome other angular amount may be used depending on the application desired." (¶ [0076].) From mirror 305a, the light then

proceeds to the Mangin mirror 306 and then to mirror 305b. (¶ [0077].)

5. Regarding the Figure 3 embodiment, Shafer discusses correcting various color aberrations (¶¶ [0081] – [0085]) and teaches that "[p]rimary axial color is corrected without field lenses by balancing the positive refractive power of the Mangin mirror element 306 with the positive power of the lenses" (¶ [0081]) and "[u]se of two field lenses 304 and 307 near the intermediate images provides for correction of both secondary axial color and primary lateral color" (¶ [0081]). Also, Shafer teaches that:

> [c]orrection of the secondary lateral color can be accomplished by balancing the secondary color between the first half of the system with the second half of the system, where the first half of the system includes all lenses from the incoming energy source up to the reflective portion of the Mangin mirror 306, including lens group 301, field lens 304, first small fold mirror 305a, and Mangin mirror 306.

(¶ [0081].)

6. The embodiments of Figures 5 and 6 are similar to that of Figure 3 (¶¶ [0088] – [0093]), and Shafer teaches that these embodiments have a disadvantage that "the optical axis of the Mangin mirror image relay is at 90 degrees to the optical axis defined by the focusing lenses" (¶ [0095]). Shafer teaches that the embodiment of Figure 7 "solves the problems of the 90 degree bend issue with respect to the Mangin mirror image relay and the internal pupil plane." (¶ [0096].)

7. The embodiment of Figure 7 describes an in-line catadioptric objective that uses a single glass material and "allows for improved design performance and relaxes manufacturing tolerances." (¶ [0096].) "For example, the decentering of any lens element by 5 microns will cause less than one quarter wave of coma without using any compensation elements. Using element decenters and tilts as compensation elements, the tolerances become even more relaxed." (¶ [0096].) In the objective 700 of Figure 7, a first field lens 703 directs light energy to folding mirror 704, which then directs the light energy toward focusing lenses 705 and 706 and to the Mangin mirror 707. (¶ [0096].) The light reflects back from the Mangin mirror 707 through focusing lenses 706 and 705 through second field lens 708 and through focusing lens arrangement 720. (¶ [0096].) The focusing lenses 705 and 706, Mangin mirror 707, second field lens 708, and focusing lens arrangement 720 are aligned substantially along a single axis. (¶ [0096]; Fig. 7.)

Yonekubo

8. Yonekubo describes an oil immersion liquid for fluorescence microscopes used for observing specimens through oil immersion type objectives. (Abstract; col. 1, ll. 7-8, 13-23; col. 2, ll. 33-36, 39-50.)

PRINCIPLES OF LAW

Section 103 forbids issuance of a patent when "the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the

invention was made to a person having ordinary skill in the art to which said subject matter pertains." *KSR Int'l Co. v. Teleflex, Inc.*, 550 U.S. 398, 406 (2007). In *KSR*, the Supreme Court reaffirmed that "[t]he combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results." *Id.* at 416. The Court explained:

> When a work is available in one field of endeavor, design incentives and other market forces can prompt variations of it, either in the same field or a different one. If a person of ordinary skill can implement a predictable variation, § 103 likely bars its patentability. For the same reason, if a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill.

Id. at 417.

"[R]ejections on obviousness grounds cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness." *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006). "To facilitate review, this analysis should be made explicit." *KSR*, 550 U.S. at 418. However, "the analysis need not seek out precise teachings directed to the specific subject matter of the challenged claim, for a court can take account of the inferences and creative steps that a person of ordinary skill in the art would employ." *Id.* The Supreme Court noted that "[u]nder the correct analysis, any need or problem known in the field of endeavor at the time of invention and addressed by the patent can provide a reason for combining the elements in the manner claimed." *Id.* at 420.

During examination of a patent application, a claim is given its broadest reasonable construction consistent with the specification. *In re Prater*, 415 F.2d 1393, 1404-05 (CCPA 1969). "[T]he words of a claim 'are generally given their ordinary and customary meaning.'" *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312 (Fed. Cir. 2005) (en banc) (internal citations omitted). The "ordinary and customary meaning of a claim term is the meaning that the term would have to a person of ordinary skill in the art in question at the time of the invention, i.e., as of the effective filing date of the patent application." *Id.* at 1313.

ANALYSIS

Appellants' arguments have not persuaded us that the Examiner erred in rejecting the claims as being obvious over the applied references.

§ 103 Rejection - Shafer / Yonekubo

As the Examiner correctly found (Ans. 4-5, 8-9; *see* FF 2, 4, 6, 7), Shafer teaches that its elements are aligned substantially along a single axis. Specifically, independent claim 43 requires the claimed objective to have "at least one focusing lens," "at least one field lens," and "at least one Mangin mirror element" where "each focusing lens and each field lens is . . . aligned substantially along an axis." Thus, the language of claim 43 only requires the claimed objective to have a single focusing lens, a single field lens, and a single Mangin mirror element. The language of claim 43 does not require the Mangin mirror element to be aligned substantially along the axis. Only the focusing lens and field lens need be so aligned. Thus, the embodiment of Shafer's Figure 3 meets the alignment limitation recited by claim 43

because field lenses 307 and focusing lens 308 are aligned substantially along an axis. (FF 4.) In addition, although the plain language of claim 43 requires only one field lens to be aligned along the axis, we note that field lens 304 also is aligned substantially along the same axis. The embodiment of Figure 7 also meets the alignment limitation of claim 43 because second field lens 708 and focusing lens arrangement 720 are aligned substantially along an axis. (FF 7.) Although the plain language of claim 43 requires only one focusing lens to be aligned along the axis, we note that focusing lenses 705 and 706 also are aligned substantially along the same axis.

Similar to independent claim 43, independent claims 55, 78, and 90 also recite "at least one focusing lens," "at least one field lens," and "at least one Mangin mirror element." Thus, similar to claim 43, the language of these claims also requires the claimed objective to have only a single focusing lens, a single field lens, and a single Mangin mirror element. However, unlike claim 43, these claims further require the Mangin mirror, the at least one focusing lens, and the at least one field lens to be "substantially aligned along a single axis."[2] The Examiner found that Shafer teaches that the off-axis Mangin mirror element of Figure 3 may be placed on the optical axis and that the claim term "substantially" does not require the elements to have exactly the same optical axis. (Ans. 9; *see* FF 4, 6, 7.) We agree.

Shafer teaches that there are disadvantages to having the Mangin mirror off-axis (FF 6), and that the in-line embodiment of Figure 7 solves these problems (FF 6, 7). The embodiment of Figure 7 teaches that the

[2] Unlike the other independent claims, independent claim 65 does not recite any alignment limitation.

Mangin mirror 707, second field lens 708, and focusing lens arrangement 720 are substantially aligned along a single axis (FF 7). Although the plain language of claims 55, 78, and 90 requires only one focusing lens to be aligned along the axis, we note that focusing lenses 705 and 706 also are aligned substantially along the same single axis.

Therefore, the Examiner has not erred in finding that Shafer teaches that its elements are aligned substantially along a single axis.

Next, under the broadest reasonable interpretation of the claim language consistent with the Specification, we agree with the Examiner that Shafer teaches that its system is configured to balance aberrations between elements, where the aberration balancing reduces decenter sensitivity of the elements of the design. (Ans. 4, 5, 8; *see* FF 1-3, 5.) The Examiner found that "[t]he prior art teaches all the claimed structural limitations and therefore would be capable of performing all the claimed functional limitations." (Ans. 8.) In addition, the Examiner found that Shafer teaches reducing chromatic aberration and increasing tolerance of decentered elements, (Ans. 8; *see* FF 2, 3, 5) and that "[i]ncreasing the tolerance is the same as reducing the sensitivity." (Ans. 8.)

Although Appellants argue that increasing tolerances is different from reducing decenter sensitivity and "decenter sensitivity is the relationship between an amount of image vibration relative to an amount of movement encountered" (Reply Br. 4 (emphasis deleted)), Appellants do not point to, nor do we find, any such particular definition in the Specification. In addition, the Specification teaches that "[o]ne advantage of the present design is relatively loose manufacturing tolerances. Specifically, the decenter tolerances of individual lenses are relatively loose." (FF 1.) Thus,

we do not see any inconsistency between the Examiner's interpretation and the Specification.

Therefore, the Examiner has not erred in finding that Shafer teaches that it is configured to balance aberrations between elements, where the aberration balancing reduces decenter sensitivity of the elements of the design.

Finally, we are not convinced by Appellants' argument that the Examiner erred by improperly combining the use of an immersion substance, as taught by Yonekubo, with the system of Shafer.

The Examiner found that, although Shafer does not teach an immersion substance, "Yonekubo teaches using an immersion substance, including water and oil, to obtain better imaging performance" (Ans. 5; *see* FF 8) and that "[i]t would have been obvious to one of ordinary skill in the art at the time the invention was made to use a well known immersion substance with the objective of Shafer as taught by Yonekubo to provide better imaging performance because of reduced reflections due to the index matching provided by the immersion substance" (Ans. 5). The Examiner found that "[t]he use of an immersion substance is extremely well known in the art to reduce reflections at the air/sample and air/objective interfaces" (Ans. 9). In addition, "the examiner believes the only complication by adding the immersion substance would be the focal point of the system changed based on the refractive index of the immersion substance" (Ans. 9) but that "[t]his problem is easily corrected by adjusting the location of the sample to correspond to the new focal point" (Ans. 9).

Appellants dispute the Examiner's reasoning in combining Shafer and Yonekubo (App. Br. 15-20; Reply Br. 5-7), however the Examiner has

articulated reasoning with rational underpinning to support the combination. We find no error in the Examiner's reasoning to combine the references. We further note that both Shafer and Yonekubo are described as being useful in fluorescence applications (FF 3, 8). Although Appellants argue that "one could not simply place an immersion substance with the Shafer 722 design" (App. Br. 18) because "the resultant device would yield a poor image and provide inadequate inspection capabilities in the environment claimed" (App. Br. 18) unless there was extensive experimentation (Reply Br. 5), Appellants have not provided any convincing reasoning or evidence to support this assertion.

Therefore, the Examiner has not improperly combined the use of an immersion substance, as taught by Yonekubo, with the system of Shafer.

Accordingly, we conclude that the Examiner has not erred in rejecting independent claims 43, 55, 65, 78, and 90 under 35 U.S.C. § 103(a). Dependent claims 44-51, 53, 54, 56-64, 66-74, 76, 77, 79-86, 88, 89, and 91-99 were not argued separately (App. Br. 20), and fall together with independent claims 43, 55, 65, 78, and 90, from which they depend.

§ 103 Rejection - Shafer / Yonekubo / Deutsch

Dependent claims 52, 75, and 87 were not argued separately, and we will sustain the rejection of these claims for the reasons discussed with respect to independent claims 43, 65, and 78, from which they depend.

CONCLUSION

Based on the findings of fact and analysis above, we conclude that the Examiner has not erred in rejecting claims 43-99.

DECISION

The rejection of claims 43-99 is affirmed.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a)(1)(iv).

AFFIRMED

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